Report for 2005KY51B: Pathogen and Sediment Transport in the Muddy Creek Subbasin, Kentucky River Watershed

Publications

- Articles in Refereed Scientific Journals:
    - LaSage, Danita, Alice Jones, and Tom Edwards, 2006, The Muddy Creek project: evolution of a field-based research and learning collaborative, Journal of Geoscience Education, 54(2), p. 109-115.
- Conference Proceedings:
    - Albright, Michael, Danita LaSage, and Alice Jones, 2006, Multi-scalar geomorphological characterization of the Muddy Creek watershed, Kentucky, in Proceedings of the Kentukcy Water Resources Annual Symposium, Kentucky Water Resources Research Institute, Lexington, Kentucky, p. 51-52.
    - Collins, Samuel, Michael Albright, and Danita LaSage, 2006, Pathogen and sediment transport in Muddy Creek, in Proceedings of the Kentucky Water Resources Annual Symposium, Kentucky Water Resources Research Institute, Lexington, Kentucky, p. 79-80.
    - LaSage, Danita, Alice Jones, and Tom Edwards, 2005, Muddy Creek: The evolution of a community-university watershed partnership, 8th Annual Southeast Watershed Roundtable and 3rd Annual Kentucky State Watershed Roundtable - Watershed strategies for a new era: Protecting the environment and the bottom line, Convened by the Southeast Watershed Forum (www.southeastwaterforum.org) and the Kentucky Waterways Alliance.

Report Follows

Problem and Research Objectives

This project focuses on Muddy Creek, a tributary of the Kentucky River that was included as a Priority 1 stream on the 2004 Kentucky 303(d) list of impaired waters. The Kentucky Chapter of the Nature Conservancy has identified the watershed as one of its five state-wide landscape-scale conservation targets because it contains examples of several pre-settlement habitats. One riparian species, running buffalo clover, is a federally protected endangered species. Threats to the health of the Muddy Creek Watershed include pathogen risk and cumulative downstream stormwater impacts from expanding suburban development. Building on a previous study (Jones, 2002KY7B), we sought to address several areas where information on Muddy Creek remained insufficient: (1) sources of fecal coliform in the upper reaches of the watershed; (2) stream hydrology and discharge information; (3) suspended sediment concentrations; and (4) the need to ground truth the accuracy of the Kentucky Gap Analysis Program ("GAP" or "Kentucky GAP") GIS land use layer.

Methodology

Water-quality data were collected approximately monthly at 7 stations, and samples for coliform analyses were collected at 15 locations. The scope of the project was changed through initiating collaboration with USGS to provide continuous water-quality monitoring at one stream station. Low flow conditions in Muddy Creek resulted in an adjustment to plans to collect quarterly discharge measurements for one year at several of the selected sites. Instead, our USGS collaboration will allow us to gather continuous discharge data at one site for three years.

We initiated a study of sediment transport in the watershed by doing cross-sectional surveys at three sites. Streambed materials were classified at each of the survey sites and GIS was utilized to construct a geomorphological model at landscape and site scales. Samples for suspended sediment analysis were collected and turbidity measurements were taken at several stations during both baseflow and stormflow conditions to establish turbidity as a surrogate for suspended sediment sampling. Finally, a multi-probe capable of collecting large amounts of turbidity data was installed at the USGS stream station.

The watershed was ground truthed by comparing the actual landscape in portions of the watershed against predicted vegetation based on currently available GIS layers. Differences in patterns of landscape type throughout the watershed were examined. Observation points were located and the vegetation types were recorded. The field observations are now being used to prepare new maps.

The number of permanent sampling sites along the farm meander was reduced from 5 to 3. We originally planned to do temperature probing along the meander as part of a hyporheic flow study to be accomplished for a master's thesis. However, the flow study proved impractical, and the temperature probing was not done.

Principal Findings and Significance

Muddy Creek remains at risk for aquatic and stream health. A particular concern is the occurrence of relatively high concentrations of coliform bacteria in the stream. Atypical Coliform/Total Coliform ratios, which indicate the age of coliform populations in streams, have been useful in larger watersheds to target point-source sewage inputs. However, AC/TC ratios were not a reliable indicator of coliform source in the Muddy Creek watershed, possibly due to the small size of the watershed and the preponderance of small, dispersed nonpoint sources of contamination (individual septic systems) rather than large point sources (such as municipal wastewater treatment plants).

Erosion and sediment loading from watershed-scale geology and local land use issues are also a source of concern. The baseline geomorphological and suspended sediment data collected during this project will be useful for future studies of sediment and erosion in the watershed. Turbidity data from large storm events or prolonged periods of rain are needed to evaluate sediment loading under bankfull conditions, the conditions under which most geomorphological work is performed.

The use of a readily available land use/land cover dataset (GAP) as an aid in identifying stressors related to human influences in a small watershed such as Muddy Creek was examined. While the GAP resolution is acceptable for understanding statewide landscape patterns, the GAP is insufficient at the watershed scale to characterize land use and therefore, not adequate for use in local water quality management programs. A methodology for rapid ground truthing ("Rapid Roadway Reconnaissance") involving delineation along publicly available corridors (roadways) with extrapolation of the results was field tested. The "Rapid Roadway Reconnaissance" methodology shows promise for application in ground truthing remotely sensed data in a cost-effective and time-efficient way, and merits further study. Future work will determine whether certain GAP land use types are more likely than others to be incorrectly classified.